# Waste Stream Analysis
# Clark County, Washington

## 2003
## FINAL REPORT


**CLARK COUNTY**
**DEPARTMENT OF PUBLIC WORKS**
**Environmental Services – Solid Waste**
**1300 Franklin Street**
**Vancouver, WA 98660**

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# 1. PROJECT OVERVIEW

## Objectives

Clark County desired a comprehensive analysis of the municipal solid waste currently generated and initially disposed within the County. The objective was to provide current reliable data for use in evaluating existing and future waste prevention and recycling programs.

## Current System

The Central Transfer Recycling Center, located at 11034 NE 117th Avenue in Vancouver, receives approximately 70% of the County's disposed waste. The remaining material arrives at the West Van Materials Recovery Center, 6601 NW Old Lower River Road, also in Vancouver. Both facilities process waste to recover recyclable materials and household hazardous waste. Residual material is disposed at the Finley Buttes landfill in Eastern Oregon. These facilities received approximately 233,200 tons of Clark County waste during the calendar year 2003. The Columbia Resource Company operates both facilities.

Waste Connections, Inc. and Waste Management, Inc. are the companies that collect the franchised residential and commercial wastes. The City of Camas hauls packer-collected wastes, which are mostly from residential sources within the City. The public brings self-hauled wastes directly to the transfer stations.

## Waste Generation Streams

The study focused on mixed municipal solid wastes, and included wastes disposed by four main classes of waste generators:

- Franchise-collected Residential - *waste originating from single-family homes and multifamily apartments, delivered to the transfer stations by a garbage collection company.*
- Franchise-collected Commercial – *non-residential waste delivered to the transfer station by a garbage collection company.*
- Residential Self-Haul - *residential waste delivered to the transfer station by a homeowner, renter or landlord.*

- Commercial Self-Haul - *non-residential waste delivered to the transfer station by the same company which generated the waste, and is someone not in the business of hauling garbage.*

Of particular interest were large-quantity or easily accessible materials such as wood and various construction debris. Major categories of potentially recoverable materials were of greater interest than detailed information on the entire spectrum of wastes. The composition component list reflects this ideology in that it contains 30 material classifications.

A clear differentiation between residential and non-residential wastes was an underlying theme for the sampling program. Sampled wastes came only from vehicles which contained 80% or more of the targeted generating class of material.

The primary goal of the sampling program was to accurately represent and estimate the composition of the overall waste stream, representing each of the generators noted above. The ability to draw statistical conclusions *between* individual generation classes was secondary. Samples were distributed relative to the tonnages of each generating class.

## Execution

Sky Valley Associates conducted the study, with the design phase beginning in March of 2003. Fieldwork was initiated in May, followed by three additional seasonal samplings in August (summer), November (fall), and February (winter 2004). Two-hundred forty samples were captured and sorted between the two facilities.

Clark County staff entered the field sampling data and compiled the 2003 waste quantities. During each sampling period, scale house staff conducted weeklong traffic surveys at both transfer stations to gather current generation information on all loads delivered to the facilities.

Cascadia Consulting Group then transferred the composition and quantity data into a customized database, and produced the composition estimates, including mean percentages and precision estimates for each of the 30 materials specified for the study. Sky Valley Associates compared these data to those from a similar 1999 study.

# 2. FINDINGS

## Comparison to 1999 Study

While there are some increases and decreases in the mean values for some materials, there have been no statistically significant changes in overall composition compared to 1999. The table below shows comparable component percentages between this study and those from a similar study conducted by Green Solutions in 1999. A one-to-one comparison is only possible for select components, since the list changed for the 2003 study

Food wastes and recoverable wood both show a slight increase in their mean value.

Rubble, now a combination of various 1999 categories, also has increased. Yard waste is up slightly, as are gypsum wallboard and composition roofing. The percentage of carpet and carpet padding has increased, but shows no statistical difference from the last study.

The overall categories of Paper, Plastic, Metal, and Glass have all decreased. The amount of aluminum beverage cans remains unchanged.

**Waste Stream Comparison**
**2003 and 1999 Percentages**

| | 2003 | 1999 |
|---|---|---|
| **Paper** | **19.2%** | **21.8%** |
| Newspaper | 1.6% | 2.1% |
| Cardboard | 4.1% | 4.7% |
| All Other Papers | 13.4% | 14.9% |
| **Plastic** | **11.6%** | **12.9%** |
| **Metal** | **7.3%** | **7.9%** |
| Aluminum Cans | 0.3% | 0.4% |
| Ferrous Metal | 3.2% | 4.4% |
| Non-Ferrous Metal | 0.2% | 0.5% |
| Aerosol Cans | 0.1% | 0.2% |
| All Other Metals | 3.5% | 2.5% |
| **Glass** | **2.3%** | **3.2%** |
| Clear Glass | 1.0% | 1.5% |
| Green Glass | 0.3% | 0.4% |
| Brown Glass | 0.5% | 0.7% |
| R/C Glass | 0.5% | 0.5% |
| **Organic** | **29.2%** | **26.3%** |
| Food Wastes | 15.1% | 14.5% |
| Yard Wastes | 3.7% | 3.3% |
| Recoverable Wood | 10.4% | 8.5% |
| **Other Materials** | **13.3%** | **10.5%** |
| Gypsum Wallboard | 2.5% | 2.2% |
| Rubble | 3.5% | 2.9% |
| Composition Roofing | 1.6% | 1.2% |
| Carpet/Carpet Pad | 4.5% | 2.8% |
| Hazardous/Special | 0.4% | 0.6% |
| Oil Filters | 0.1% | 0.1% |
| Household Batteries | 0.1% | 0.1% |
| Electronics | 0.6% | 0.6% |
| **Remaining Waste** | **17.1%** | **17.5%** |
| | **100.0%** | **100.0%** |

## 2003 Highlights

Food wastes accounted for 35,700 tons in 2003, or 15% of the total disposed waste stream, and are the largest single component of waste. Residential collection accounts for more than 70% of all food waste.

Wood represents 10% of the waste stream with 24,200 tons delivered to the two transfer stations. Other construction-related debris such as rubble (aggregates), gypsum wallboard, carpet, and roofing

represent another 28,400 tons, for a combined 12% of the total tonnage. Including wood wastes, almost a quarter of the waste stream relates to construction activity.

Mixed waste paper accounts for over 16,400 tons of material, and approximately 9,400 tons of cardboard and 3,800 tons of newspaper was disposed. Other compostable papers amount to 8,600 tons.

Plastic bottles and containers (#1 through #7 resins) amount to 5,000 tons; 2,700 estimated tons of bottles, and 2,300 estimated tons of containers. Potentially recoverable polyethylene films contribute another 3,900 tons of plastic.

The largest category of pure metal is ferrous metal, at 7,300 tons. Aluminum cans and other non-ferrous metals add another 1,300 tons. Mixed metal (metals contaminated with other material) is the largest metal category at 7,700 tons.

An estimated 4,100 tons of bottle and container glass are being disposed with 95% of it coming from Waste Connections, Waste Management and City of Camas garbage customers.

Yard debris represented 8,800 tons. Ninety percent of this material comes from garbage collection, split equally between residential and commercial sources.

Household electronics represent 0.6% of the waste stream, equating to nearly 1,400 tons of computers, audio/visual equipment, and other household electronic devices.

Reusable products account for at least 5,200 additional tons per year including clothing, linens, toys, utensils and dishes, pictures, books, and furniture - anything the sampling crew thought someone else could use again.

The amount of potentially hazardous materials is relatively low, less than 1% of the wastes. Household batteries and oil filters were the only components identified separately in the study, and each appears at less than 0.1% or approximately 140 tons apiece. Based on the individual filter weights obtained in the study, this represents up to 150,000 disposed oil filters annually.

Residue wastes including materials such as cigarettes, feminine hygiene products, diapers, rubber, contaminated wood, textiles, and animal wastes totaled 34,900 tons, these materials represent nearly 15% of the waste stream. Of this tonnage, an estimated 5,000 tons each are animal wastes and diapers, and over 3,000 tons are textiles.

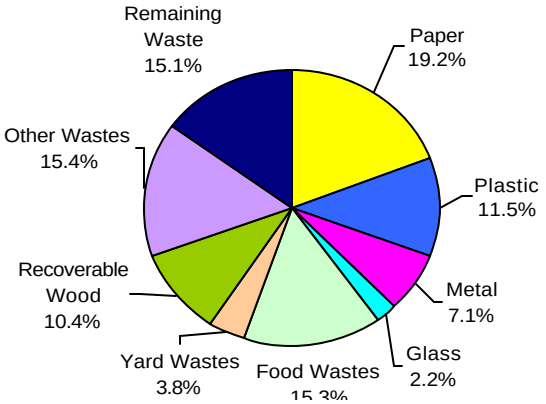
The adjacent table 2003 Overall Waste Stream shows estimated current composition and substream tonnages. Following sections further describe the wastes by residential, non-residential, and self-haul sources.

## 2003 Overall Waste Stream

### Waste Composition and Quantities

| | Overall Tonnage | Mean Percent | Low | High | Collected Residential Tons | Collected Commercial Tons | Self-Haul Tons |
|---|---|---|---|---|---|---|---|
| **Paper** | **44,785** | **19.20%** | | | **24,379** | **16,833** | **3,260** |
| Newspaper | 3,774 | 1.62% | 1.36% | 1.88% | 2,485 | 1,157 | 117 |
| Cardboard | 9.350 | 4.01% | 3.29% | 4.73% | 3.706 | 4.101 | 1.742 |
| Mixed Paper | 16.405 | 7.03% | 6.28% | 7.79% | 10.723 | 5.101 | 456 |
| Compostable Paper | 8,643 | 3.71% | 3.36% | 4.05% | 5,585 | 2,612 | 144 |
| R/C Paper | 6.613 | 2.84% | 1.94% | 3.73% | 1.880 | 3.863 | 800 |
| **Plastic** | **26,872** | **11.52%** | | | **14,697** | **8,950** | **3,204** |
| Bottles & Containers | 5,029 | 2.16% | 1.92% | 2.39% | 3,737 | 1,211 | 143 |
| Recoverable Film | 3.910 | 1.68% | 1.18% | 2.17% | 1.815 | 2.064 | 90 |
| R/C Plastics | 17,933 | 7.69% | 6.80% | 8.58% | 9,145 | 5,675 | 2,971 |
| **Metal** | **16,623** | **7.13%** | | | **7,185** | **5,860** | **4,069** |
| Aluminum Cans | 770 | 0.33% | 0.30% | 0.36% | 563 | 185 | 22 |
| Ferrous Metal | 7.302 | 3.13% | 2.44% | 3.82% | 2.947 | 3.013 | 1.498 |
| Non-Ferrous Metal | 533 | 0.23% | 0.19% | 0.27% | 317 | 94 | 109 |
| Aerosol Cans | 315 | 0.13% | 0.12% | 0.15% | 245 | 51 | 4 |
| R/C Metals | 7,703 | 3.30% | 2.41% | 4.20% | 3,112 | 2,518 | 2,437 |
| **Glass** | **5,175** | **2.22%** | | | **3,522** | **1,338** | **365** |
| Clear Glass | 2.221 | 0.95% | 0.84% | 0.95% | 1.713 | 401 | 116 |
| Green Glass | 662 | 0.28% | 0.22% | 0.28% | 504 | 118 | 32 |
| Brown Glass | 1.173 | 0.50% | 0.39% | 0.50% | 880 | 275 | 72 |
| R/C Glass | 1.119 | 0.48% | 0.29% | 0.48% | 425 | 543 | 145 |
| **Organic** | **68,696** | **29.46%** | | | **34,371** | **22,082** | **11,663** |
| Food Wastes | 35,734 | 15.32% | 13.96% | 16.68% | 25,464 | 8,811 | 534 |
| Yard Wastes | 8.801 | 3.77% | 2.78% | 4.76% | 4.295 | 3.541 | 759 |
| Recoverable Wood | 24,161 | 10.36% | 8.30% | 12.42% | 4,613 | 9,730 | 10,369 |
| **Other Wastes** | **35,912** | **15.40%** | | | **10,081** | **10,340** | **16,372** |
| Gypsum Wallboard | 6.063 | 2.60% | 1.62% | 3.58% | 1.678 | 1.989 | 2.443 |
| Rubble | 8,320 | 3.57% | 2.26% | 4.88% | 1,653 | 4,047 | 2,517 |
| Composition Roofing | 3.872 | 1.66% | 0.51% | 2.82% | 1.325 | 407 | 2.355 |
| Carpet/Carpet Pad | 10.119 | 4.34% | 2.56% | 6.12% | 1.967 | 1.833 | 6.653 |
| Hazardous/Special | 954 | 0.41% | 0.04% | 0.78% | 203 | 788 | 11 |
| Electronics | 1.378 | 0.59% | 0.36% | 0.83% | 707 | 374 | 345 |
| Reusable Products | 5,205 | 2.23% | 1.02% | 3.45% | 2,548 | 901 | 2,047 |
| **Remaining Waste** | **35,156** | **15.07%** | | | **22,369** | **7,531** | **4,749** |
| Residue Wastes | 34.879 | 14.96% | 13.30% | 16.61% | 22.161 | 7.518 | 4.696 |
| Oil Filters | 138 | 0.06% | 0.03% | 0.09% | 86 | 4 | 50 |
| Household Batteries | 139 | 0.06% | 0.05% | 0.07% | 122 | 10 | 2 |
| **Totals:** | **233,218** | | | | **116,605** | **72,934** | **43,680** |

*Calculated at a 90% confidence level; 240 samples*



# 3. COLLECTED RESIDENTIAL WASTES

Waste Connections, Waste Management and the City of Camas contributed an estimated 116,600 of residential wastes to Clark County's waste stream. This is half of the total disposed waste stream and is comprised of 65% from homes and 35% from apartments, by weight.

v Residential collection contributes 25,500 tons of food waste, over 70% all food discarded.

√ Collection accounts for 2,500 tons of newspaper, 10,700 tons of mixed waste paper, and 3,700 tons of cardboard. This represents 65% of all newspaper and mixed recyclable waste papers, and 40% of all cardboard.

√ The residential substream contributes 3,100 tons of glass bottles and containers, over 75% of the total.

√ Over seventy-percent of all plastic bottles and containers are from collected residential waste, amounting to 3,700 tons of material.

√ Recoverable films, at 1,800 tons, represent 45% of the total for this material.

√ The majority of aluminum beverage cans originate from households and apartments accounting for 560 of 770 total tons or 73%.

√ The 2,900 tons of ferrous metal from residential collection represent 40% of all ferrous metals.

√ Nearly 4,300 tons of yard waste arrived from route-collected, residential sources, half of the systems yard debris tonnage.

√ Route-collected residential garbage is the primary source of small, household batteries, 120 tons, and over 60% of all oil filters, or 86 tons.

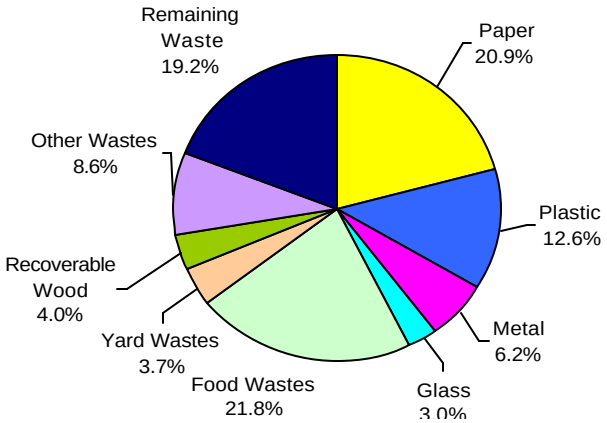
The adjacent table, 2003 Overall Collected Residential, displays the composition of the collected residential waste stream and the source tonnages contributed by single-family and multifamily collection. Appendix B shows the individual single-family and multifamily estimates.

## 2003 Overall Collected Residential

### Waste Composition and Quantities

| | Overall Tonnage | Mean Percent | Low | High | Collected Single-family Tons | Collected Multifamily Tons |
|---|---|---|---|---|---|---|
| **Paper** | **24,379** | **20.91%** | | | **16,519** | **7,860** |
| Newspaper | 2.485 | 2.13% | 1.80% | 2.46% | 1.629 | 856 |
| Cardboard | 3,706 | 3.18% | 2.71% | 3.64% | 1,980 | 1,726 |
| Mixed Paper | 10.723 | 9.20% | 8.24% | 10.16% | 7.273 | 3.450 |
| Compostable Paper | 5,585 | 4.79% | 4.45% | 5.13% | 4,266 | 1,318 |
| R/C Paper | 1.880 | 1.61% | 1.42% | 1.80% | 1.370 | 510 |
| **Plastic** | **14,697** | **12.60%** | | | **9,622** | **5,075** |
| Bottles & Containers | 3,737 | 3.21% | 2.66% | 3.75% | 2,274 | 1,463 |
| Recoverable Film | 1.815 | 1.56% | 1.18% | 1.94% | 1.048 | 767 |
| R/C Plastics | 9.145 | 7.84% | 7.23% | 8.45% | 6.300 | 2.845 |
| **Metal** | **7,185** | **6.16%** | | | **3,683** | **3,502** |
| Aluminum Cans | 563 | 0.48% | 0.44% | 0.53% | 361 | 202 |
| Ferrous Metal | 2.947 | 2.53% | 1.98% | 3.07% | 1.640 | 1.307 |
| Non-Ferrous Metal | 317 | 0.27% | 0.24% | 0.30% | 233 | 84 |
| Aerosol Cans | 245 | 0.21% | 0.18% | 0.24% | 193 | 52 |
| R/C Metals | 3,112 | 2.67% | 1.45% | 3.89% | 1,255 | 1,857 |
| **Glass** | **3,522** | **3.02%** | | | **2,126** | **1,397** |
| Clear Glass | 1.713 | 1.47% | 1.28% | 1.47% | 1.089 | 624 |
| Green Glass | 504 | 0.43% | 0.33% | 0.43% | 332 | 173 |
| Brown Glass | 880 | 0.75% | 0.56% | 0.75% | 412 | 468 |
| R/C Glass | 425 | 0.36% | 0.29% | 0.36% | 293 | 132 |
| **Organic** | **34,371** | **29.48%** | | | **23,952** | **10,419** |
| Food Wastes | 25,464 | 21.84% | 20.37% | 23.31% | 18,377 | 7,087 |
| Yard Wastes | 4.295 | 3.68% | 2.75% | 4.61% | 3.212 | 1.083 |
| Recoverable Wood | 4,613 | 3.96% | 2.67% | 5.24% | 2,363 | 2,250 |
| **Other Wastes** | **10,081** | **8.65%** | | | **4,680** | **5,400** |
| Gypsum Wallboard | 1.678 | 1.44% | 0.51% | 2.37% | 1.385 | 293 |
| Rubble | 1.653 | 1.42% | 0.72% | 2.12% | 1.239 | 414 |
| Composition Roofing | 1,325 | 1.14% | 0.00% | 2.64% | 234 | 1,091 |
| Carpet/Carpet Pad | 1.967 | 1.69% | 0.86% | 2.51% | 592 | 1.374 |
| Hazardous/Special | 203 | 0.17% | 0.05% | 0.30% | 33 | 170 |
| Electronics | 707 | 0.61% | 0.31% | 0.90% | 344 | 363 |
| Reusable Products | 2,548 | 2.19% | 0.47% | 3.90% | 852 | 1,696 |
| **Remaining Waste** | **22,369** | **19.18%** | | | **15,965** | **6,404** |
| Residue Wastes | 22.161 | 19.01% | 17.49% | 20.52% | 15.820 | 6.342 |
| Oil Filters | 86 | 0.07% | 0.03% | 0.11% | 53 | 33 |
| Household Batteries | 122 | 0.10% | 0.08% | 0.13% | 92 | 29 |
| **Totals:** | **116,605** | | | | **76,547** | **40,058** |

*Calculated at a 90% confidence level; 115 samples (88 single-family; 27 multi-family)*



# 4. COLLECTED COMMERCIAL WASTES

Waste Connections, Waste Management and the City of Camas contributed an estimated 73,000 of commercial wastes to Clark County's waste stream which accounts for thirty-one percent of the County's total disposal tonnage.

- √ Food and wood are the largest components in the non-residential collected waste stream each accounting for approximately 12% of the business waste stream, for a combined total of 18,500 tons. Forty percent of all wood originates from collected commercial waste, and 25% of all food.

- √ The commercial waste stream contains significant amounts of recoverable or compostable paper, with 4,100 tons of cardboard, 5,100 tons of mixed waste paper, 1,200 tons of newspaper, and 2,600 tons of other compostable paper.

- √ This business waste stream contains 1,200 tons of plastic bottles and containers, and 2,100 tons of potentially recoverable film.

- √ Ferrous metals are almost twice as common in commercial loads compared to residential wastes. Due to the smaller size of the commercial waste stream, however, the amount of 3,000 tons equals that of collected residential wastes.

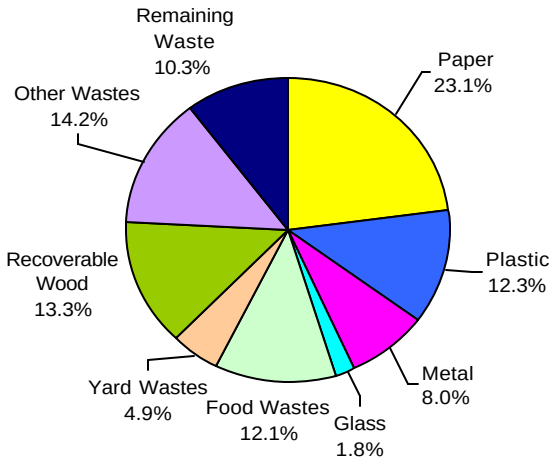
- √ Construction-related wastes, including wood, amount to 18,000 tons. This is one-quarter of the commercial collection tonnage.

The composition and detailed component tonnages for collected commercial garbage are shown in the table 2003 Overall Collected Commercial. Composition estimates by type of commercial collection truck are included in Appendix C.

## 2003 Overall Collected Commercial
### Waste Composition and Quantities

| | Overall Tonnage | Mean Percent | Low | High |
|---|---|---|---|---|
| **Paper** | **16,833** | **23.08%** | | |
| Newspaper | 1.157 | 1.59% | 0.95% | 2.23% |
| Cardboard | 4,101 | 5.62% | 3.70% | 7.54% |
| Mixed Paper | 5.101 | 6.99% | 5.14% | 8.85% |
| Compostable Paper | 2,612 | 3.58% | 2.79% | 4.37% |
| R/C Paper | 3.863 | 5.30% | 2.56% | 8.04% |
| **Plastic** | **8,950** | **12.27%** | | |
| Bottles & Containers | 1,211 | 1.66% | 1.29% | 2.04% |
| Recoverable Film | 2.064 | 2.83% | 1.34% | 4.31% |
| R/C Plastics | 5.675 | 7.78% | 5.78% | 9.78% |
| **Metal** | **5,860** | **8.03%** | | |
| Aluminum Cans | 185 | 0.25% | 0.19% | 0.32% |
| Ferrous Metal | 3.013 | 4.13% | 2.40% | 5.87% |
| Non-Ferrous Metal | 94 | 0.13% | 0.08% | 0.18% |
| Aerosol Cans | 51 | 0.07% | 0.04% | 0.10% |
| R/C Metals | 2,518 | 3.45% | 2.01% | 4.90% |
| **Glass** | **1,338** | **1.83%** | | |
| Clear Glass | 401 | 0.55% | 0.40% | 0.55% |
| Green Glass | 118 | 0.16% | 0.08% | 0.16% |
| Brown Glass | 275 | 0.38% | 0.19% | 0.38% |
| R/C Glass | 543 | 0.74% | 0.18% | 0.75% |
| **Organic** | **22,082** | **30.28%** | | |
| Food Wastes | 8,811 | 12.08% | 8.86% | 15.30% |
| Yard Wastes | 3.541 | 4.86% | 2.30% | 7.41% |
| Recoverable Wood | 9,730 | 13.34% | 9.40% | 17.29% |
| **Other Wastes** | **10,340** | **14.18%** | | |
| Gypsum Wallboard | 1.989 | 2.73% | 1.17% | 4.28% |
| Rubble | 4.047 | 5.55% | 2.29% | 8.80% |
| Composition Roofing | 407 | 0.56% | 0.14% | 0.97% |
| Carpet/Carpet Pad | 1.833 | 2.51% | 0.39% | 4.64% |
| Hazardous/Special | 788 | 1.08% | 0.00% | 2.27% |
| Electronics | 374 | 0.51% | 0.10% | 0.92% |
| Reusable Products | 901 | 1.24% | 0.23% | 2.24% |
| **Remaining Waste** | **7,531** | **10.33%** | | |
| Residue Wastes | 7.518 | 10.31% | 7.12% | 13.50% |
| Oil Filters | 4 | 0.00% | 0.00% | 0.01% |
| Household Batteries | 10 | 0.01% | 0.01% | 0.02% |
| **Totals:** | **72,934** | | | |

*Calculated at a 90% confidence level; 80 samples*



# 5. SELF-HAULED WASTES

## ***Residential and Commercial Self-Haul Estimates***

*Self-haul wastes are highly variable, and the 45 total (21 residential and 24 commercial) self-haul samples are not sufficient to draw strong conclusions from this data. Splitting these samples further into residential and commercial substreams, the numbers become even more variable. The intended purpose of the small sampling of self-haul is to represent these wastes proportionally in the overall sampling.*

- √ Self-hauled wastes are approximately 19% of the total system tonnage. Homeowners and landlords bring in 28,480 tons. Businesses deliver an additional 15,200 tons.
- √ Recoverable wood is the largest component of self-hauled wastes at 10,400 tons; this represents 43% of all wood wastes.
- √ Approximately 2,500 tons of recyclable or compostable paper comes from this substream, with cardboard contributing 1,700 tons.
- √ The largest recoverable metal category for these wastes is ferrous metal, at 1,500 tons.
- √ Aside from wood, other construction-related materials such as gypsum wallboard, rubble, composition roofing, and carpeting represent 14,000 tons of material, approximately 30% of all self-hauled wastes.
- √ More than a third of all reusable products originated from self-haul loads, the majority from residential sources.
- √ Approximately 35% of all the oil filters are in the self-haul waste stream.

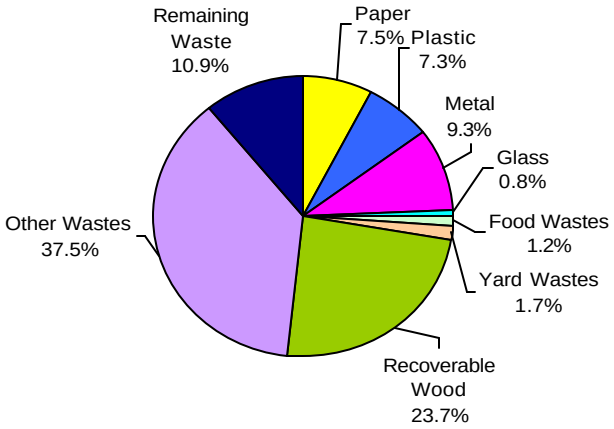
The composition and detailed component tonnages for self-hauled garbage are shown in the table 2003 Overall Self-Haul.

## 2003 Overall Self-Haul

### Waste Composition and Quantities

| | Overall Tonnage | Mean Percent | Low | High | Self-Haul Residential Tons | Self-Haul Commercial Tons |
|---|---|---|---|---|---|---|
| **Paper** | **3,260** | **7.46%** | | | **1,633** | **1,628** |
| Newspaper | 117 | 0.27% | 0.08% | 0.45% | 90 | 27 |
| Cardboard | 1,742 | 3.99% | 2.22% | 5.76% | 962 | 780 |
| Mixed Paper | 456 | 1.04% | 0.56% | 1.53% | 341 | 118 |
| Compostable Paper | 144 | 0.33% | 0.10% | 0.56% | 110 | 34 |
| R/C Paper | 800 | 1.83% | 0.40% | 3.26% | 131 | 669 |
| **Plastic** | **3,204** | **7.33%** | | | **1,525** | **1,678** |
| Bottles & Containers | 143 | 0.33% | 0.15% | 0.51% | 79 | 64 |
| Recoverable Film | 90 | 0.21% | 0.08% | 0.33% | 69 | 20 |
| R/C Plastics | 2.971 | 6.80% | 3.82% | 9.78% | 1.376 | 1.594 |
| **Metal** | **4,069** | **9.32%** | | | **2,677** | **1,392** |
| Aluminum Cans | 22 | 0.05% | 0.01% | 0.09% | 19 | 2 |
| Ferrous Metal | 1.498 | 3.43% | 1.42% | 5.44% | 1.171 | 327 |
| Non-Ferrous Metal | 109 | 0.25% | 0.05% | 0.45% | 101 | 8 |
| Aerosol Cans | 4 | 0.01% | 0.00% | 0.02% | 0 | 4 |
| R/C Metals | 2,437 | 5.58% | 2.22% | 8.94% | 1,386 | 1,050 |
| **Glass** | **365** | **0.83%** | | | **232** | **132** |
| Clear Glass | 116 | 0.26% | 0.06% | 0.26% | 87 | 28 |
| Green Glass | 32 | 0.07% | 0.00% | 0.07% | 30 | 2 |
| Brown Glass | 72 | 0.16% | 0.00% | 0.16% | 70 | 2 |
| R/C Glass | 145 | 0.33% | 0.00% | 0.33% | 46 | 100 |
| **Organic** | **11,663** | **26.70%** | | | **8,036** | **3,626** |
| Food Wastes | 534 | 1.22% | 0.26% | 2.19% | 414 | 120 |
| Yard Wastes | 759 | 1.74% | 0.22% | 3.26% | 446 | 314 |
| Recoverable Wood | 10,369 | 23.74% | 15.84% | 31.64% | 7,177 | 3,192 |
| **Other Wastes** | **16,372** | **37.48%** | | | **10,595** | **5,775** |
| Gypsum Wallboard | 2.443 | 5.59% | 2.06% | 9.12% | 205 | 2.238 |
| Rubble | 2.517 | 5.76% | 2.11% | 9.42% | 1.987 | 529 |
| Composition Roofing | 2,355 | 5.39% | 0.13% | 10.65% | 1,247 | 1,108 |
| Carpet/Carpet Pad | 6.653 | 15.23% | 6.59% | 23.88% | 4.830 | 1.823 |
| Hazardous/Special | 11 | 0.03% | 0.00% | 0.07% | 11 | 0 |
| Electronics | 345 | 0.79% | 0.00% | 1.62% | 345 | 0 |
| Reusable Products | 2,047 | 4.69% | 0.00% | 9.81% | 1,969 | 78 |
| **Remaining Waste** | **4,749** | **10.87%** | | | **3,781** | **969** |
| Residue Wastes | 4.696 | 10.75% | 4.87% | 16.63% | 3.729 | 969 |
| Oil Filters | 50 | 0.11% | 0.00% | 0.25% | 50 | 0 |
| Household Batteries | 2 | 0.00% | 0.00% | 0.01% | 2 | 0 |
| **Totals:** | **43,680** | | | | **28,480** | **15,200** |

*Calculated at a 90% confidence level; 45 samples*



# 6. RECOMMENDATIONS

## Program Opportunities

- ✓ Continue existing wood waste and yard waste diversion programs, look for opportunities to increase diversion or recovery;
- ✓ Increase or implement programs which address construction-related debris, particularly in self-hauled and collected commercial wastes;
- ✓ Educate route-collected residential customers regarding the disposal of batteries, oil filters and aerosol cans;
- ✓ Educate those with access to curbside recycling about papers, cans and bottles;
- ✓ Promote programs to foster greater re-use, exchange, or resale of serviceable items;
- ✓ Consider recovery options for carpet and carpet padding;
- ✓ Consider adding food waste to the residential yard debris collection program;
- ✓ Consider editing garbage bill cost components to show a savings from recycling rather than a cost.

## Future Waste Stream Analysis Study

Successful diversion planning requires accurate information about the characteristics of the material you target. This will involve the generator, the collector, the processor, and the solid waste planner. Future waste stream analyses could include:

- *Conducting generator-based sampling* - sampling/surveying specific types of generators to refine estimates of composition and quantity. This can include structured, or 'pure load', sampling of groups of similar generators.

- *Perform a self-haul and roll-off composition study* – wastes contained in self-haul and roll-off vehicles are relatively accessible, facilitating both voluntary separation and post-disposal recovery efforts. These wastes lend themselves well to hand-separation recovery techniques.

- *Compare findings and programs to other jurisdictions* – assess potential opportunities by comparison with similar counties in Washington and Oregon.

# APPENDIX

# A. SAMPLING PERIOD RESULTS

## 2003/2004 Sampling Period Results

### Mean Composition Overall

| | Overall Mean | May 2003 | August 2003 | November 2003 | February 2004 |
|---|---|---|---|---|---|
| ***Paper*** | **19.2%** | **17.3%** | **17.9%** | **15.4%** | **25.2%** |
| Newspaper | 1.6% | 1.8% | 1.2% | 1.5% | 1.4% |
| Cardboard | 4.0% | 3.7% | 4.9% | 3.0% | 6.1% |
| Mixed Paper | 7.0% | 6.1% | 6.4% | 6.1% | 8.1% |
| Compostable Paper | 3.7% | 2.6% | 3.2% | 3.8% | 4.2% |
| R/C Paper | 2.8% | 3.0% | 2.3% | 1.1% | 5.5% |
| ***Plastic*** | **11.5%** | **10.5%** | **10.9%** | **10.3%** | **12.5%** |
| #1 - 7 Bottles/Containers | 2.2% | 2.0% | 2.1% | 1.9% | 2.0% |
| Recoverable Film | 1.7% | 0.7% | 4.0% | 0.9% | 0.6% |
| R/C Plastics | 7.7% | 7.8% | 4.8% | 7.5% | 9.9% |
| ***Metal*** | **7.1%** | **7.1%** | **8.0%** | **8.6%** | **4.6%** |
| Aluminum Cans | 0.3% | 0.3% | 0.3% | 0.3% | 0.3% |
| Ferrous Metal | 3.1% | 4.2% | 1.9% | 4.6% | 1.8% |
| Non-Ferrous Metal | 0.2% | 0.3% | 0.2% | 0.2% | 0.3% |
| Aerosol Cans | 0.1% | 0.1% | 0.1% | 0.2% | 0.1% |
| R/C Metals | 3.3% | 2.2% | 5.5% | 3.4% | 2.0% |
| ***Glass*** | **2.2%** | **2.6%** | **2.0%** | **1.6%** | **2.7%** |
| Clear Glass | 1.0% | 0.7% | 1.0% | 0.7% | 1.2% |
| Green Glass | 0.3% | 0.2% | 0.1% | 0.3% | 0.5% |
| Brown Glass | 0.5% | 0.5% | 0.6% | 0.3% | 0.7% |
| R/C Glass | 0.5% | 1.2% | 0.3% | 0.3% | 0.4% |
| **Organic** | **29.5%** | **27.7%** | **30.4%** | **34.4%** | **21.5%** |
| Food Wastes | 15.3% | 12.3% | 14.3% | 16.1% | 15.4% |
| Yard Wastes | 3.8% | 4.3% | 3.3% | 5.1% | 2.0% |
| Recoverable Wood | 10.4% | 11.2% | 12.9% | 13.2% | 4.1% |
| **Other Wastes** | **15.4%** | **22.1%** | **13.9%** | **18.5%** | **17.1%** |
| Gypsum Wallboard | 2.6% | 2.8% | 3.3% | 2.0% | 3.4% |
| Rubble | 3.6% | 5.7% | 0.6% | 6.7% | 4.5% |
| Composition Roofing | 1.7% | 1.7% | 0.5% | 1.9% | 7.6% |
| Carpet/Carpet Pad | 4.3% | 8.0% | 4.7% | 5.6% | 0.7% |
| Hazardous/Special | 0.4% | 0.2% | 0.1% | 0.9% | 0.4% |
| Electronics | 0.6% | 0.9% | 0.8% | 0.4% | 0.1% |
| Reusable Products | 2.2% | 2.8% | 3.9% | 1.0% | 0.3% |
| **Remaining Waste** | **15.1%** | **12.6%** | **16.8%** | **11.0%** | **16.3%** |
| Residue Wastes | 15.0% | 12.5% | 16.7% | 10.9% | 16.1% |
| Oil Filters | 0.1% | 0.0% | 0.1% | 0.1% | 0.1% |
| Household Batteries | 0.1% | 0.0% | 0.1% | 0.1% | 0.1% |
| | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** |
| *Number of Samples:* | *240* | *60* | *61* | *58* | *61* |

# B. SINGLE-FAMILY & MULTIFAMILY RESULTS

## 2003 Collected Single-family Residential
### Waste Composition and Quantities

| | Tons | Mean | Low | High | | Tons | Mean | Low | High |
|---|---|---|---|---|---|---|---|---|---|
| ***Paper*** | **16,519** | **21.58%** | | | ***Organic*** | **23,952** | **31.29%** | | |
| Newspaper | 1,629 | 2.13% | 1.76% | 2.50% | Food Wastes | 18,377 | 24.01% | 22.79% | 25.22% |
| Cardboard | 1,980 | 2.59% | 2.16% | 3.01% | Yard Wastes | 3,212 | 4.20% | 2.91% | 5.48% |
| Mixed Paper | 7,273 | 9.50% | 8.68% | 10.32% | Recoverable Wood | 2,363 | 3.09% | 1.90% | 4.27% |
| Compostable Paper | 4,266 | 5.57% | 5.23% | 5.92% | ***Other Wastes*** | **4,680** | **6.11%** | | |
| R/C Paper | 1,370 | 1.79% | 1.56% | 2.02% | Gypsum Wallboard | 1,385 | 1.81% | 0.47% | 3.15% |
| ***Plastic*** | **9,622** | **12.57%** | | | Rubble | 1,239 | 1.62% | 0.61% | 2.62% |
| Bottles & Containers | 2,274 | 2.97% | 2.81% | 3.13% | Composition Roofing | 234 | 0.31% | 0.01% | 0.60% |
| Recoverable Film | 1,048 | 1.37% | 1.06% | 1.68% | Carpet/Carpet Pad | 592 | 0.77% | 0.46% | 1.09% |
| R/C Plastics | 6,300 | 8.23% | 7.60% | 8.86% | Hazardous/Special | 33 | 0.04% | 0.02% | 0.07% |
| ***Metal*** | **3,683** | **4.81%** | | | Electronics | 344 | 0.45% | 0.22% | 0.67% |
| Aluminum Cans | 361 | 0.47% | 0.42% | 0.53% | Reusable Products | 852 | 1.11% | 0.66% | 1.56% |
| Ferrous Metal | 1,640 | 2.14% | 1.88% | 2.40% | ***Remaining Waste*** | **15,965** | **20.86%** | | |
| Non-Ferrous Metal | 233 | 0.30% | 0.27% | 0.34% | Residue Wastes | 15,820 | 20.67% | 18.91% | 22.42% |
| Aerosol Cans | 193 | 0.25% | 0.22% | 0.28% | Oil Filters | 53 | 0.07% | 0.03% | 0.11% |
| R/C Metals | 1,255 | 1.64% | 1.29% | 1.99% | Household Batteries | 92 | 0.12% | 0.09% | 0.15% |
| ***Glass*** | **2,126** | **2.78%** | | | | | | | |
| Clear Glass | 1,089 | 1.42% | 1.23% | 1.42% | | | | | |
| Green Glass | 332 | 0.43% | 0.32% | 0.43% | | | | | |
| Brown Glass | 412 | 0.54% | 0.43% | 0.54% | **Total Tons** | **76,547** | | | |
| R/C Glass | 293 | 0.38% | 0.28% | 0.38% | | | | | |

*Calculated at a 90% confidence level; 88 samples*

## 2003 Collected Multifamily Residential
### Waste Composition and Quantities

| | Tons | Mean | Low | High | | Tons | Mean | Low | High |
|---|---|---|---|---|---|---|---|---|---|
| ***Paper*** | **7,860** | **19.62%** | | | ***Organic*** | **10,419** | **26.01%** | | |
| Newspaper | 856 | 2.14% | 1.50% | 2.78% | Food Wastes | 7,087 | 17.69% | 14.09% | 21.29% |
| Cardboard | 1,726 | 4.31% | 3.22% | 5.39% | Yard Wastes | 1,083 | 2.70% | 1.55% | 3.86% |
| Mixed Paper | 3,450 | 8.61% | 6.30% | 10.93% | Recoverable Wood | 2,250 | 5.62% | 2.63% | 8.61% |
| Compostable Paper | 1,318 | 3.29% | 2.56% | 4.02% | ***Other Wastes*** | **5,400** | **13.48%** | | |
| R/C Paper | 510 | 1.27% | 0.91% | 1.63% | Gypsum Wallboard | 293 | 0.73% | 0.00% | 1.62% |
| ***Plastic*** | **5,075** | **12.67%** | | | Rubble | 414 | 1.03% | 0.35% | 1.71% |
| Bottles & Containers | 1,463 | 3.65% | 2.11% | 5.19% | Composition Roofing | 1,091 | 2.72% | 0.00% | 7.06% |
| Recoverable Film | 767 | 1.92% | 0.97% | 2.86% | Carpet/Carpet Pad | 1,374 | 3.43% | 1.10% | 5.76% |
| R/C Plastics | 2,845 | 7.10% | 5.80% | 8.41% | Hazardous/Special | 170 | 0.42% | 0.06% | 0.79% |
| ***Metal*** | **3,502** | **8.74%** | | | Electronics | 363 | 0.91% | 0.16% | 1.65% |
| Aluminum Cans | 202 | 0.50% | 0.41% | 0.60% | Reusable Products | 1,696 | 4.23% | 0.00% | 9.16% |
| Ferrous Metal | 1,307 | 3.26% | 1.76% | 4.76% | ***Remaining Waste*** | **6,404** | **15.99%** | | |
| Non-Ferrous Metal | 84 | 0.21% | 0.16% | 0.26% | Residue Wastes | 6,342 | 15.83% | 12.95% | 18.71% |
| Aerosol Cans | 52 | 0.13% | 0.09% | 0.17% | Oil Filters | 33 | 0.08% | 0.00% | 0.17% |
| R/C Metals | 1,857 | 4.64% | 1.15% | 8.12% | Household Batteries | 29 | 0.07% | 0.03% | 0.12% |
| ***Glass*** | **1,397** | **3.49%** | | | | | | | |
| Clear Glass | 624 | 1.56% | 1.16% | 1.56% | | | | | |
| Green Glass | 173 | 0.43% | 0.23% | 0.43% | | | | | |
| Brown Glass | 468 | 1.17% | 0.65% | 1.17% | **Total Tons** | **40,058** | | | |
| R/C Glass | 132 | 0.33% | 0.21% | 0.33% | | | | | |

*Calculated at a 90% confidence level; 27 samples*

# C. COMMERCIAL PACKER & ROLL-OFF RESULTS

## 2003 Collected Commercial Packer Trucks
### Waste Composition and Quantities

| | Tons | Mean | Low | High |
|---|---|---|---|---|
| ***Paper*** | **9,553** | **29.06%** | | |
| Newspaper | 807 | 2.45% | 1.35% | 3.56% |
| Cardboard | 1,246 | 3.79% | 2.54% | 5.04% |
| Mixed Paper | 3,905 | 11.88% | 7.96% | 15.79% |
| Compostable Paper | 1,951 | 5.94% | 4.48% | 7.39% |
| R/C Paper | 1,644 | 5.00% | 1.40% | 8.60% |
| ***Plastic*** | **4,498** | **13.68%** | | |
| #1 - 7 Bottles & Conta | 706 | 2.15% | 1.73% | 2.56% |
| Recoverable Film | 598 | 1.82% | 1.01% | 2.62% |
| R/C Plastics | 3,194 | 9.71% | 6.36% | 13.07% |
| ***Metal*** | **2,140** | **6.51%** | | |
| Aluminum Cans | 108 | 0.33% | 0.25% | 0.41% |
| Ferrous Metal | 1,137 | 3.46% | 2.01% | 4.90% |
| Non-Ferrous Metal | 63 | 0.19% | 0.13% | 0.26% |
| Aerosol Cans | 46 | 0.14% | 0.07% | 0.21% |
| R/C Metals | 787 | 2.39% | 0.57% | 4.21% |
| ***Glass*** | **992** | **3.02%** | | |
| Clear Glass | 276 | 0.84% | 0.62% | 0.84% |
| Green Glass | 84 | 0.26% | 0.10% | 0.26% |
| Brown Glass | 177 | 0.54% | 0.25% | 0.54% |
| R/C Glass | 455 | 1.38% | 0.15% | 1.39% |

| | Tons | Mean | Low | High |
|---|---|---|---|---|
| ***Organic*** | **10,314** | **31.37%** | | |
| Food Wastes | 6,541 | 19.89% | 14.53% | 25.26% |
| Yard Wastes | 1,380 | 4.20% | 1.12% | 7.28% |
| Recoverable Wood | 2,393 | 7.28% | 2.77% | 11.79% |
| ***Other Wastes*** | **2,318** | **7.05%** | | |
| Gypsum Wallboard | 130 | 0.40% | 0.03% | 0.76% |
| Rubble | 490 | 1.49% | 0.30% | 2.68% |
| Composition Roofing | 153 | 0.46% | 0.00% | 1.11% |
| Carpet/Carpet Pad | 589 | 1.79% | 0.14% | 3.44% |
| Hazardous/Special | 538 | 1.64% | 0.00% | 4.16% |
| Electronics | 324 | 0.99% | 0.11% | 1.86% |
| Reusable Products | 95 | 0.29% | 0.04% | 0.54% |
| ***Remaining Waste*** | **3,062** | **9.31%** | | |
| Residue Wastes | 3,050 | 9.28% | 5.38% | 13.17% |
| Oil Filters | 4 | 0.01% | 0.00% | 0.03% |
| Household Batteries | 8 | 0.03% | 0.01% | 0.04% |
| **Total Tons** | **32,877** | | | |

*Calculated at a 90% confidence level; 36 samples*

## 2003 Collected Commercial Roll-off Trucks
### Waste Composition and Quantities

| | Tons | Mean | Low | High | | Tons | Mean | Low | High |
|---|---|---|---|---|---|---|---|---|---|
| ***Paper*** | **7,280** | **18.17%** | | | ***Organic*** | **11,769** | **29.38%** | | |
| Newspaper | 351 | 0.88% | 0.15% | 1.60% | Food Wastes | 2,270 | 5.67% | 1.80% | 9.54% |
| Cardboard | 2,855 | 7.13% | 3.79% | 10.47% | Yard Wastes | 2,161 | 5.39% | 1.48% | 9.31% |
| Mixed Paper | 1,196 | 2.99% | 1.96% | 4.01% | Recoverable Wood | 7,337 | 18.32% | 12.16% | 24.47% |
| Compostable Paper | 660 | 1.65% | 0.86% | 2.44% | ***Other Wastes*** | **8,021** | **20.03%** | | |
| R/C Paper | 2,218 | 5.54% | 1.52% | 9.56% | Gypsum Wallboard | 1,859 | 4.64% | 1.83% | 7.45% |
| ***Plastic*** | **4,451** | **11.11%** | | | Rubble | 3,557 | 8.88% | 3.04% | 14.72% |
| #1 - 7 Bottles & Conta | 505 | 1.26% | 0.67% | 1.85% | Composition Roofing | 255 | 0.64% | 0.10% | 1.17% |
| Recoverable Film | 1,466 | 3.66% | 1.04% | 6.28% | Carpet/Carpet Pad | 1,244 | 3.11% | 0.00% | 6.74% |
| R/C Plastics | 2,481 | 6.19% | 3.82% | 8.57% | Hazardous/Special | 250 | 0.62% | 0.00% | 1.26% |
| ***Metal*** | **3,720** | **9.29%** | | | Electronics | 50 | 0.12% | 0.00% | 0.31% |
| Aluminum Cans | 77 | 0.19% | 0.09% | 0.29% | Reusable Products | 806 | 2.01% | 0.20% | 3.82% |
| Ferrous Metal | 1,876 | 4.68% | 1.76% | 7.61% | ***Remaining Waste*** | **4,469** | **11.16%** | | |
| Non-Ferrous Metal | 31 | 0.08% | 0.01% | 0.15% | Residue Wastes | 4,468 | 11.15% | 6.30% | 16.01% |
| Aerosol Cans | 5 | 0.01% | 0.00% | 0.02% | Oil Filters | 0 | 0.00% | 0.00% | 0.00% |
| R/C Metals | 1,731 | 4.32% | 2.16% | 6.49% | Household Batteries | 1 | 0.00% | 0.00% | 0.01% |
| ***Glass*** | **346** | **0.86%** | | | | | | | |
| Clear Glass | 126 | 0.31% | 0.11% | 0.31% | | | | | |
| Green Glass | 34 | 0.08% | 0.01% | 0.08% | | | | | |
| Brown Glass | 98 | 0.25% | 0.00% | 0.25% | **Total Tons** | **40,057** | | | |
| R/C Glass | 88 | 0.22% | 0.07% | 0.22% | | | | | |

*Calculated at a 90% confidence level; 44 samples*

# D. STUDY METHODOLOGY

## Program Design

The objective of the sampling program was to provide statistically significant composition estimates for the targeted generator/hauler categories, or waste "substreams". Defined by both their generation and transport characteristics, we evaluated these substreams in terms of their quantity, location, and delivery system.

The two garbage companies deliver franchise-collected wastes using compacting packer trucks and roll-off boxes. The City of Camas delivers wastes in compacting packer trucks only.

Self-hauled wastes arrive in almost any type of vehicle, but generally consist of small-capacity vehicles such as autos, vans, pick-ups, and flat beds. These wastes can also be delivered by roll-offs and packers, from larger companies or institutions.

### Estimation of Substream Quantities

We assessed tonnages using information provided by the two haulers, along with current Clark County transaction data. This assessment considered the relative quantities delivered by type of vehicle, type of generator, and disposal location.

We distributed the samples relative to the disposal quantities for each facility, hauler, generator class, and vehicle type. Quantity and location information for loads which were purely commercial (business waste) versus pure multifamily (residential apartment waste) were available only as an estimate from each of the haulers. Haulers often combine apartment waste in mixed loads of packer-collected material as part of the "commercial" waste stream. Although we had a definitive quantity estimate for apartment roll-offs, the amount of multifamily waste within the packers was an estimate. This was an important step in the design, as the need to sample pure commercial and pure multifamily wastes was a key issue. The intent was to sample only from vehicles whose material was 90% or more of one waste generator class.

Scale house data and County information were used to calculate the quantity estimates and the split between residential and non-residential material for self-hauled wastes.

We constructed a sampling scheme to distribute 240 samples between the generation classes relative to the quantity of each, at an average rate of 60 samples each sampling period. We were unsure whether enough pure apartment packers were available without having to conduct special collections.

## Determination of Sampling Days

We selected a random start day in each season, from which a four or five-day sampling period followed. The relatively small number of days in the field (sixteen), spread over four quarters, meant that day-of-week traffic flows were a concern. We evaluated these days to ensure that vehicle flows were sufficient and representative. The design considered all days of the week, resulting in one Saturday sampling. All other samplings occurred during regular weekday operations.

## Sample Load Selection

Scale house data and hauler information specific to each day determined the total population of loads and corresponding quantities received at each facility. To the greatest extent possible, we segregated quantities by single-family packer, single-family roll-off, multifamily packer, multifamily roll-off, commercial packer, commercial roll-off, residential self-haul and commercial self-haul. We then allocated samples to each waste substream based on these estimates.

The 'population' for each substream was the total number of anticipated truckloads. We conducted a "systematic sampling" (this process is described below) of all classes of vehicles, with the exception that we targeted some sampling of pure-load multifamily and commercial packers to meet design quotas. We pre-arranged sample captures very early in the morning with the facilities and haulers for specific days, to gain access to such loads. This proved successful, and generally we were able to sample enough loads of each type.

The "systematic sampling" process used for this study involved estimating sampling intervals by dividing the number of desired vehicles into the total number of those vehicles expected each day. The result was an interval where we sampled every "$n^{th}$" vehicle, providing it met the criteria for the substream it represented. If it did not, we selected the next arriving vehicle of its class.

Prior to sampling, we contacted each hauler and both facilities to confirm anticipated numbers of loads and their arrival times, and to alert all parties of any specific loads targeted for sampling. We monitored the daily capture progress and adjusted intervals to account for unanticipated variances in vehicular flow.

## Field Methodology

### Sample Capture

When a sample load arrived, we interviewed the driver of the vehicle to confirm that the selection of the load was correct and to collect pertinent load information. The driver then unloaded the waste in

the designated area, and the site staff was alerted to the loads arrival. With the direction of the field supervisor, the loader operator extracted the appropriate cell of material, and placed it on a tarp in the sorting area.

An imaginary 16-cell grid identified the random sample cell for sampling. If the designated cell was inaccessible, an alternate cell was selected. Typically, this meant selecting either the mirror image or opposite adjacent cell.

## Sample Sorting

We sorted an average of 250 pounds of waste for each sample into the prescribed 30 component categories. We weighed most materials using a 250-pound digital scale accurate to 0.1 pounds, and small items on a 10-pound scale of 0.01- pound accuracy.

Individual tally sheets held the combined component data and header (load) information for each sample. Load information included the generation characteristics of the waste, the type of vehicle, load origin, transaction number, and other information. We forwarded the completed tally sheets to Clark County staff for data entry.

# Composition Analysis

## Composition Calculations

The composition estimates represent the ratio of the individual material components' weight to the total waste for each noted waste stream (e.g., the percent of newspaper, by weight, of all waste originating from franchised residential sources). The calculation summed each component's weight across all of the selected records and divided by the sum of the total weight of waste, as shown in the following equation:

$$r_j = \frac{\sum_i c_{ij}}{\sum_i w_i}$$

where:
c = weight of particular component
w = sum of all component weights for i = 1 to n
where n = number of selected samples for j = 1 to m
where m = number of components

We calculated the confidence interval for this estimate in two steps. First, the variance around the estimate is calculated, accounting for the fact that the ratio includes two random variables (the component and total sample weights). The variance of the ratio estimator equation follows:

$$\hat{V}_{r_j} = \left(\frac{1}{n}\right) \cdot \left(\frac{1}{\overline{w}^2}\right) \cdot \left( \frac{\sum_i \left(c_{ij} - r_j w_i\right)^2}{n-1} \right)$$

where:

$$\overline{w} = \frac{\sum_i w_i}{n}$$

Next, we calculated precision levels at the 90% confidence interval for a component's mean as follows:

$$r_j \pm \left(t \cdot \sqrt{\hat{V}_{r_j}}\right)$$

where:

t = the value of the t-statistic (1.645) corresponding to a 90% confidence level

For more detail, please refer to Chapter 6 "Ratio, Regression and Difference Estimation" of Elementary Survey Sampling by R.L. Scheaffer, W. Mendenhall and L. Ott (PWS Publishers, 1986).

## Combining Composition and Quantities

We used a weighted average calculation to estimate the composition of the overall waste stream, as well as for the overall collected residential, collected single-family residential, collected multifamily residential and overall collected commercial waste substreams. We also weighted the four seasonal samplings. This calculation averages the composition of waste from various strata (or groups), assigning relative importance to samples from each. We developed the weightings using 2003 tonnages.

Table 1 lists the weighting groups, tonnages, and associated weighting factors used to calculate waste composition estimates for the overall waste stream. For example, waste samples originating from franchise residential sources were assigned an importance of about 50% (0.50 in decimal form). We assigned these samples far more importance than those from commercial self-haul loads (at 0.07,

or over 7% of the total). Tables 2 through Table 10 list the weighting groups, tonnages, and proportions used to produce composition estimates for the remaining weighted substreams:

*Overall Collected Residential – waste collected from homes and apartments by a franchised garbage hauler or the City of Camas.*

*Overall Collected Commercial – waste collected from businesses by a franchised garbage hauler or the City of Camas.*

*Overall Self-Haul – waste self-delivered to a transfer station by a homeowner, landlord, or business.*

*Collected Single-family Residential – waste collected from homes by a franchised garbage hauler or the City of Camas.*

*Collected Multifamily Residential – waste collected from apartments by a franchised garbage hauler.*

*Seasons – wastes sampled in May, August, November, and February*

We performed unweighted analyses to produce composition estimates for the following groups:

*Self-haul Residential – waste from residential sources*

*Self-haul Commercial – waste from commercial sources*

For all but the seasonal estimates, we applied annual tonnages to the waste composition percentage estimates from the corresponding samples to produce a complete waste quantity profile. For example, if newspaper accounted for 5% and the total annual waste disposed was 100,000 tons, newspaper accounted for a total of 5,000 tons of all wastes.

The calculation for the weighted average for a composition estimate is as follows:

$$O_j = \left(p_1 * r_{j1}\right) + \left(p_2 * r_{j2}\right) + \left(p_3 * r_{j3}\right) + \ldots$$

where:

p = the proportion of tonnage contributed by the noted waste substream

r = ratio of individual material component weight to total waste weight in the noted waste substream for j = 1 to m

where m = number of material components

The variance of the weighted average was calculated:

$$VarO_j = \left(p_1^{\,2} * \hat{V}_{r_{j1}}\right) + \left(p_2^{\,2} * \hat{V}_{r_{j2}}\right) + \left(p_3^{\,2} * \hat{V}_{r_{j3}}\right) + \ldots$$

Table 1: Weighting Proportions, Overall 2003 Waste Stream

| Weighting Group | Annual Tons | Percent |
|---|---|---|
| Commercial Franchised | 72,934 | 31% |
| Commercial Self-haul | 15,200 | 7% |
| Residential Franchised | 116,605 | 50% |
| Residential Self-haul | 28,480 | 12% |
| | 233,218 | 100% |

Table 2: Weighting Proportions, Overall Collected Residential

| Weighting Group | Annual Tons | Percent |
|---|---|---|
| Single-family Packer | 70,178 | 60% |
| Single-family Roll-off | 6,369 | 5% |
| Multifamily Packer | 26,455 | 23% |
| Multifamily Roll-off | 13,603 | 12% |
| | 116,605 | 100% |

Table 3: Weighting Proportions, Overall Collected Commercial

| Weighting Group | Annual Tons | Percent |
|---|---|---|
| Commercial Packer | 32,877 | 45% |
| Commercial Roll-off | 40,057 | 55% |
| | 72,934 | 100% |

Table 4. Weighting Proportions, Overall Self-Haul

| Weighting Group | Annual Tons | Percent |
|---|---|---|
| Residential Self-haul | 28,480 | 65% |
| Commercial Self-haul | 15,200 | 35% |
| | 43,680 | 100% |

Table 5: Weighting Proportions, Collected Single-family Residential

| Weighting Group | Annual Tons | Percent |
|---|---|---|
| Single-family Packer | 70,178 | 92% |
| Single-family Roll-off | 6,369 | 8% |
| | 76,547 | 100% |

Table 6: Weighting Proportions, Collected Multifamily Residential

| Weighting Group | Annual Tons | Percent |
|---|---|---|
| Multifamily Packer | 26,455 | 66% |
| Multifamily Roll-off | 13,603 | 34% |
| | 40,058 | 100% |

Table 7: Weighting Proportions, Spring Sampling

| Weighting Group | Percent |
|---|---|
| Commercial Franchised Packer | 13% |
| Commercial Franchised Roll-off | 16% |
| Commercial Self-haul | 9% |
| Multifamily Franchised Packer | 11% |
| Multifamily Franchised Roll-off | 5% |
| Single-family Franchised Packer | 28% |
| Single-family Franchised Roll-off | 3% |
| Residential Self-haul | 16% |
| | 100% |

Table 8: Weighting Proportions, Summer Sampling

| Weighting Group | Percent |
|---|---|
| Commercial Franchised Packer | 13% |
| Commercial Franchised Roll-off | 16% |
| Commercial Self-haul | 9% |
| Multifamily Franchised Packer | 10% |
| Multifamily Franchised Roll-off | 5% |
| Single-family Franchised Packer | 28% |
| Single-family Franchised Roll-off | 2% |
| Residential Self-haul | 17% |
| | 100% |

Table 9: Weighting Proportions, Autumn Sampling[1]

| Weighting Group | Percent |
|---|---|
| Commercial Franchised Packer | 14% |
| Commercial Franchised Roll-off | 17% |
| Commercial Self-haul | 8% |
| Multifamily Franchised Packer | 11% |
| Multifamily Franchised Roll-off | 6% |
| Single-family Franchised Packer | 30% |
| Residential Self-haul | 14% |
| | 100% |

[1] Single-family roll-offs are not reflected in this table because no samples were taken from this generation class during the autumn sampling period.

Table 10: Weighting Proportions, Winter Sampling[2]

| Weighting Group | Percent |
|---|---|
| Commercial Franchised Packer | 14% |
| Commercial Franchised Roll-off | 17% |
| Commercial Self-haul | 8% |
| Multifamily Franchised Packer | 11% |
| Single-family Franchised Packer | 31% |
| Single-family Franchised Roll-off | 3% |
| Residential Self-haul | 16% |
| | 100% |

[2] Multifamily roll-offs are not reflected in this table because no samples were taken from this generation class during the winter sampling period.

# E. COMPONENT DEFINITIONS

All samples were sorted into the following component categories. These category definitions differ from those used in the 1999 study.

## PAPERS

Newspaper: Printed ground wood newsprint, including advertising "slicks" (glossy paper), and non-printed (packing) newspaper.

Cardboard: Unwaxed/uncoated corrugated container boxes and kraft paper, including brown paper bags.

Mixed Paper: Mixed paper grades, including junk mail, magazines, colored papers, bleached or colored kraft, boxboard, mailing tubes, carbonless copy paper, ground wood, paperback books, telephone directories, white and colored bond, copy papers, notebook paper, envelopes, and other stationary grade paper.

Compostable Paper: Paper towels, paper plates, waxed paper, tissues, napkins, and other papers normally soiled with food or body fluids during use (e.g., pizza box inserts, fast food boxes, and food wrappers).

Remainder/Composite Paper: Predominantly paper with other materials attached (e.g. orange juice cans and spiral notebooks), and other non-recyclable papers such as carbon copy paper, hardcover books, and photographs.

## PLASTICS

#1 – 7 Bottles and Containers: Rigid plastic bottles and containers of all sizes, with or without closures. This category includes natural and colored bottles, wide mouth jars and tubs, clamshells, and salad trays. It does not include lids, cookie tray inserts, plastic spools, and toothpaste tubes.

Recoverable Film: Clean polyethylene film and bags not contaminated with food, liquid or grit from use. This category includes shrink-wrap, newspaper and dry cleaner bags, store bags, and garbage or lawn bags not used for disposal.

Remainder/Composite Plastics: Items that are predominately plastic with other materials attached such as disposable razors, pens, lighters, toys, and 3-ring binders. Finished plastic products made entirely of plastic such as toys, toothbrushes, vinyl hose, forks and spoons, plastic lawn furniture. It includes fiberglass resin products and materials, film packaging not defined above, or contaminated with food, liquid or grit during use. This category includes packaging materials not noted above, such as lids, inserts, non-bottle/container rigid packing, spools, and mixed-material plastic packaging.

## METALS

Aluminum Cans: Aluminum beverage cans and bi-metal cans made mostly of aluminum.

Ferrous Metal: Steel food containers, including bi-metal cans mostly of steel, furniture, and ferrous and alloyed ferrous scrap metals to which a magnet adheres and not significantly contaminated with other metals or materials.

Non-ferrous Metal: Metals not derived from iron, to which a magnet will not adhere, not significantly contaminated with other metals or materials. This category includes aluminum products and scrap such as window frames, furniture, cookware, food containers, trays, and foil.

Aerosol Cans: Empty, mixed material/metal aerosol cans.

Remainder/Composite Metals: Items that are predominately metal with other materials attached such as motors, insulated wire, and finished products containing a mixture of metals, or metals and other materials. This includes items such as small appliances, cookware, toys, and furniture.

## GLASS

Clear Glass: Bottles and containers which are clear in color, including beverage, liquid and container glass.

Green Glass: Bottles and containers which are green in color, including beverage, liquid and container glass.

Brown Glass: Bottles and containers which are brown in color, including beverage, liquid and container glass.

Remainder/Composite Glass: All glass except that noted above, including fluorescent light tubes window and flat glass, mirrors, light bulbs, glassware, and blue glass containers.

## ORGANICS

Food Wastes: Food wastes and scraps, including bone, rinds, etc. Excludes the weight of food containers, except when container weight is not appreciable compared to the food inside, or when food is not readily removable. Biodegradable packaging peanuts are also included in this category.

Yard Wastes: All vegetation and plant materials, including grass clippings, leaves, weeds, prunings and stumps.

Recoverable Wood: All untreated and treated wood not contaminated with other materials. This includes new and demolition lumber and plywood, pallets, crates, furniture and other packaging or products made of wood.

## OTHER WASTES

Gypsum Wallboard: New scrap and demolition drywall, except that significantly contaminated with other material, such as tile or stucco.

Rubble: Rock, gravel, sand, dirt, cement, brick, ceramics, and porcelain are included in this category.

Composition Roofing: Asphalt roofing shingles and tarpaper.

Carpet/Carpet Pad: All carpeting and padding, natural or synthetic.

Hazardous/Special: Paints, solvents, adhesives, cleaners, pesticides, herbicides, acid batteries, oils, fuels, medical wastes, sharps, and other potentially harmful wastes are included in this category.

Electronics: Household electronics and audio/visual equipment, such as stereos, radios, televisions, computer equipment, VCRs, and cell phones.

Re-useable Products: Anything the sampling crew thought someone else could use again. This included clothing, linens, toys, utensils and dishes, pictures, books, and furniture – anything of significant size which could be cleaned and reused.

## REMAINING WASTE

Residue Wastes: Material not otherwise classified, including diapers, mixed construction debris, miscellaneous organics and inorganic materials, feces, mattresses, bulky items, large appliances, textiles, rubber, and mixed, non-distinct fines.

Oil Filters: Metal oil filters used in cars and other automobiles.

Household Batteries: Dry-cell batteries of various sizes and types as commonly used in households, including cell phone and button cell batteries.

# F. FIELD TALLY SHEET

| | | | | |
|---|---|---|---|---|
| **PAPERS** | | | | |
| Newspaper | | | | |
| Cardboard | | | | |
| Mixed Paper | | | | |
| Compostable Paper | | | | |
| R/C Paper | | | | |
| **PLASTICS** | | | | |
| #1 - 7 Bottles & Containers | | | | |
| Recoverable Film | | | | |
| R/C Plastics | | | | |
| **METALS** | | | | |
| Aluminum Cans | | | | |
| Ferrous Metal | | | | |
| Non-Ferrous Metal | | | | |
| Aerosol Cans | | | | |
| R/C Metals | | | | |
| **GLASS** | | | | |
| Clear Glass | | | | |
| Green Glass | | | | |
| Brown Glass | | | | |
| R/C Glass | | | | |
| **ORGANICS** | | | | |
| Food Wastes | | | | |
| Yard Wastes | | | | |
| Recoverable Wood | | | | |
| **OTHER WASTES** | | | | |
| Gypsum Wallboard | | | | |
| Rubble | | | | |
| Composition Roofing | | | | |
| Carpet/Carpet Pad | | | | |
| Hazardous/Special | | | | |
| Electronics | | | | |
| Reusable Products | | | | |
| **REMAINING WASTE** | | | | |
| Residue Wastes | | | | |
| Oil Filters | | | Count: | |
| Household Batteries | | | | |

**SAMPLE NO:**

**DATE:**

**LOCATION:** 1 WEST VAN
2 CTR

**HAULER:**

**ROUTE:**

**TRUCK NO.:**

**VEHICLE TYPE:** 1 FRONT LOADER
2 REAR LOADER
3 SIDE LOADER
4 RO COMPACTOR
5 RO DROP BOX
6 PICK UP
7 LARGE OTHER

**GENERATOR TYPE:** 1 RESIDENTIAL FRANCHISE
2 RESIDENTIAL SELF-HAUL
3 COMMERCIAL FRANCHISE
4 COMMERCIAL SELF-HAUL

**ORIGIN ZIP CODE:**

**NET LOAD WEIGHT:**

**COMMENTS:**

**TRANSACTION NUMBER:**

*2003 Clark County Tally* *Sky Valley Associates*

# G. ACKNOWLEGEMENTS

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